

## PATENT COOPERATION TREATY

PCT

## INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY



(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

REC'D 26 OCT 2005

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Applicant's or agent's file reference 758.1509WOU1	<b>FOR FURTHER ACTION</b> See Form PCT/PEA/416	
International application No. PCT/US2004/018536	International filing date (day/month/year) 10.06.2004	Priority date (day/month/year) 12.06.2003
International Patent Classification (IPC) or national classification and IPC F01N3/035, F01N3/20, F01N3/025, F01N3/08		
Applicant DONALDSON COMPANY, INC. et al.		
<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 5 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input type="checkbox"/> sent to the applicant and to the International Bureau) a total of sheets, as follows:</p> <p><input type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>		
<p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the opinion</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI Certain documents cited</p> <p><input checked="" type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input type="checkbox"/> Box No. VIII Certain observations on the international application</p>		
Date of submission of the demand  22.04.2005	Date of completion of this report  27.10.2005	
Name and mailing address of the international preliminary examining authority:  European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016	Authorized Officer  Louchet, N  Telephone No. +31 70 340-4212 	

**INTERNATIONAL PRELIMINARY REPORT  
ON PATENTABILITY**

International application No.  
PCT/US2004/018536

**Box No. I Basis of the report**

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
  - ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
    - ☐ international search (under Rules 12.3 and 23.1(b))
    - ☐ publication of the international application (under Rule 12.4)
    - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements\*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

**Description, Pages**

1-17 as originally filed

**Claims, Numbers**

1-9 as originally filed  
10-16 as amended (together with any statement) under Art. 19 PCT  
17-26 filed with telefax on 22.04.2005

**Drawings, Sheets**

1/6-6/6 as originally filed

- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing
3. ☐ The amendments have resulted in the cancellation of:
    - ☐ the description, pages
    - ☐ the claims, Nos.
    - ☐ the drawings, sheets/figs
    - ☐ the sequence listing (*specify*):
    - ☐ any table(s) related to sequence listing (*specify*):
  4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
    - ☐ the description, pages
    - ☐ the claims, Nos.
    - ☐ the drawings, sheets/figs
    - ☐ the sequence listing (*specify*):
    - ☐ any table(s) related to sequence listing (*specify*):

\* If item 4 applies, some or all of these sheets may be marked "superseded."

**INTERNATIONAL PRELIMINARY REPORT  
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International application No.  
PCT/US2004/018536

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**Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

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**1. Statement**

Novelty (N)	Yes: Claims	4-9, 12-14, 16, 17, 18, 20, 21, 25, 26
	No: Claims	1-3, 10, 11, 15, 19, 22-24,
Inventive step (IS)	Yes: Claims	5
	No: Claims	1-4, 626
Industrial applicability (IA)	Yes: Claims	1-26
	No: Claims	

**2. Citations and explanations (Rule 70.7):**

**see separate sheet**

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**Box No. VII Certain defects in the international application**

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The following defects in the form or contents of the international application have been noted:

**see separate sheet**

**Item V.**

1.1. Document US 6 487 852 (D1) discloses (see column 1, line 7 - column 3, line 18; figure 1):

a method for injecting fuel into a transient exhaust stream (12) of an exhaust system (10), the method comprising:

selecting a control volume within the exhaust system; and

using a model derived from a transient energy balance equation for the control volume to determining the rate for fuel to be dispensed into the exhaust stream (12).

Therefore, the present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claims 1 is not new in the sense of Article 33(2) PCT.

1.2. Document EP 1 149 991 (D3) discloses (see § [001]-[012]; figures 1-3):

An exhaust system comprising:

an exhaust conduit (90);

a fuel injection nozzle (110) positionned into the exhaust conduit (90);

an air line for supplying air to the nozzle (114);

a fuel line (106 for supplying fuel to the nozzle (114); and

a controller (120) for determining a rate of fuel to be injected into the exhaust conduit.

Therefore, the present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claim 10 is not new in the sense of Article 33(2) PCT.

2.1. Dependent claims 2-4, 6-9 and 11-26 do not appear to contain any additional features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT with respect to novelty or inventive step, because the subject-matter of claims 2, 3 are already known from EP 1 273 773 (D4) (see § [021]-[071]; figure 1), the features of claims 11, 15, 19, 22-24 are known from D3, the features of claims 7-9 are known from US 5 950 422 (D5) (see col. 2, line 3 - col. 7, line 16; figures 1-3) in combination with D2 and the features of claims 4, 6, 12-14, 16-18, 20, 21, 25 and 26 are a matter of design choice falling within the normal activity of the person skilled in

the art.

**Item VII.**

2.1. Independent claims 1 and 10 are not in the two-part form in accordance with Rule 6.3(b) PCT, which in the present case would be appropriate, with those features known in combination from the prior art being placed in the preamble (Rule 6.3(b)(I) PCT) and with the remaining features being included in the characterising part (Rule 6.3(b)(ii) PCT).

2.2. The features of the claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).

2.3. The units of pressure employed in claims 17-21 and on pages 13, 14 are not additionally expressed in terms of the units stipulated by Rule 10.1(a) PCT.

We claim:

1. A method for injecting fuel into a transient exhaust stream of an exhaust system, the method comprising:  
 selecting a control volume within the exhaust system; and  
 using a model derived from a transient energy balance equation for the control volume to determining the rate for fuel to be dispensed into the exhaust stream.
2. The method of claim 1, wherein the control volume includes a catalytic converter, wherein the catalytic converter is positioned upstream from a diesel particulate filter, wherein the fuel is dispensed upstream of the catalytic converter, and wherein rate for dispensing the fuel is selected to achieve a temperature at a downstream end of the catalytic converter that is suitable for causing regeneration of the diesel particulate filter without causing the diesel particulate filter to overheat.
3. The method of claim 1, wherein the exhaust system includes a catalytic converter positioned upstream from a diesel particulate filter and a fuel dispensing nozzle positioned upstream from the catalytic converter, and wherein the control volume starts upstream from the fuel dispensing nozzle and ends at the downstream end of the catalytic converter.
4. The method of claim 1, further comprising accessing pressure, temperature and mass flow data for the exhaust system, and using the data in concert with the model to determine the rate of fuel to be injected.
5. The method of claim 1, wherein the exhaust system includes a catalytic converter positioned upstream from a diesel particulate filter and a fuel injector positioned upstream from the catalytic converter, wherein temperature and pressure data are sensed upstream of the fuel injector and downstream of the catalytic converter, and wherein the temperature and pressure data are used in concert with the model to determine a fuel injection rate suitable to reach a temperature at the downstream end of the catalytic converter that is within a target temperature range.

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6. The method of claim 2, wherein the model takes into consideration the vaporization efficiency of the fuel.
7. The method of claim 2, wherein the model takes into consideration the fuel conversion efficiency of the catalytic converter.
8. The method of claim 2, wherein the model takes into consideration the thermal energy storage rate of the catalytic converter.
9. The method of claim 2, wherein the model takes into consideration mass flow through the control volume.
10. An exhaust system comprising:
  - an exhaust conduit;
  - a fuel injection nozzle for injecting fuel into the exhaust conduit;
  - an air line for supplying air to the nozzle;
  - a fuel line for supplying fuel to the nozzle; and
  - a controller for determining a rate of fuel to be injected into the exhaust conduit.
11. The exhaust system of claim 10, further comprising a pre-mix region in which the air and fuel are mixed prior to reaching the nozzle.
12. The exhaust system of claim 10, wherein the air and fuel are mixed at the nozzle.
13. The exhaust system of claim 1, further comprising a catalytic converter and a diesel particulate filter positioned within the exhaust conduit, the catalytic converter being positioned upstream of the diesel particulate filter and the nozzle being positioned upstream from the catalytic converter.
14. The exhaust system of claim 13, wherein the controller controls a rate of fuel injected into the exhaust conduit by the fuel injection nozzle to reach a temperature at the diesel particulate filter suitable for causing regeneration.

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15. The exhaust system of claim 10, wherein the nozzle is positioned upstream from a lean NOx catalyst.

16. The exhaust system of claim 10, wherein the nozzle is positioned upstream from a NOx absorber.